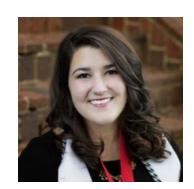
# The Right Size: Designing Autonomous Teams to go the Distance











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From a team science perspective, is a smaller or larger team more equipt for deep space exploration missions and long periods of isolation?

### Two perspectives on team size...

#### Smaller teams

- potentially more cohesive
- contributions identifiable, less social loafing (Petty, Harkins, Williams & Latane, 1977)

### Larger teams

- stimulus variety
- greater breadth of skills and expertise
- greater scientific productivity(Suster, 2010)

### **Research Questions**

RQ1: What is the effect of team size on the performance, motivation and effort of individual teammates?

RQ2: How do an individual's contributions to team tasks change over time in isolation?

# Method: Participants & Setting

#### Research Settings:

• McMurdo and Amundsen-Scott Stations in Antarctica

#### Participants:

• **N**= 47

#### Observation Days:

- Summer/Winter March June 2020
- Weeks 4, 6, 8, 10 & 12

# Method: Independent Variables

**Team size** manipulated - small (4) or large (6) via deception

**Days in isolation** - winter over participants; surveyed on days 44, 56, 71, 85, and 99

# Method: Team Size Manipulation

- Team size manipulated via survey instructions:
  - "Congratulations! You are now a member of a 4person team. You and 3 other people will be working collectively on a series of tasks."
  - "You will be Teammate 1, and your teammates will be Teammates 2, 3, and 4."
  - "Please allow a few moments for the rest of your 4person team to submit their responses."

# Method: Design

 Individuals randomly assigned to condition, and completed the tasks in alternating team sizes

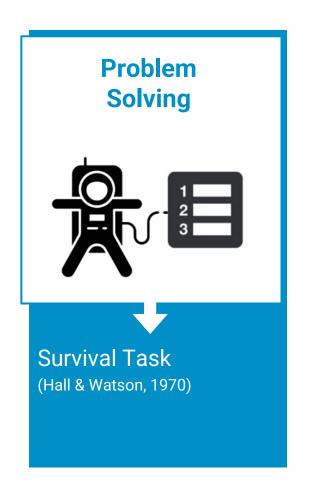
Person 1: size 4, size 6, size 4, size 6, size 4

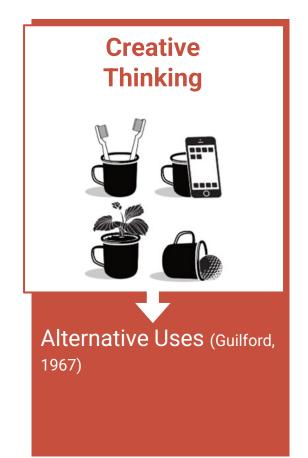
Person 2: size 6, size 4, size 6, size 4, size 6

• Tasks: Problem solving and creative thinking (from HERA)

### Method: Team Tasks

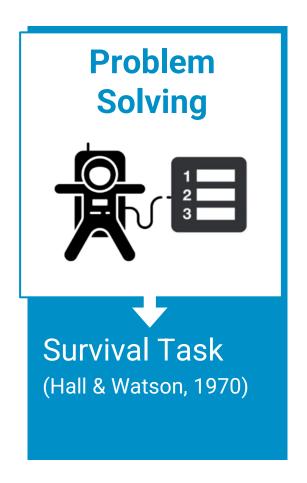
Intellective tasks require the group to solve a problem that has a correct answer.





Creative thinking tasks require the group to generate ideas that do not yet exist.

# Method: Problem Solving Task



You are a member of a space crew originally scheduled to rendezvous with a mother ship on the lighted surface of the moon. However, due to mechanical difficulties, your ship was forced to land at a spot some 200 miles from the rendezvous point. During reentry and landing, much of the equipment aboard was damaged and, since survival depends on reaching the mother ship, the most critical items available must be chosen for the 200-mile trip. Below are listed the 15 items left intact and undamaged after landing. Your task is to rank order them in terms of their importance for your crew in allowing them to reach the rendezvous point.

Items to Rank	Stellar map
Box of matches	Self-inflating life raft
Food concentrate	Magnetic compass
50 feet of nylon rope	5 gallons of water
Parachute silk	Signal flares
Portable heating unit	First aid kit, including injection needle
Two .45 caliber pistols	Solar-powered FM receiver-transmitter
One case of dehydrated milk	Two 100 lb tanks of oxygen

# Method: Problem Solving Task

	Teammate 1 (You)	Teammate 2	Teammate 3	Teammate 4
A sextant	13 not as important as food		15 it wouldn't be useful without other tools	
A shaving mirror	5	1 You can use the suns reflection to signal for help		
A quantity of mosquito netting	8			14 mosquitos aren't in the middle of the ocean
A 5 gallon can of water	3			

"This table shows you items for which there was the most difference among rankings provided by you and your teammates. The cells with entries for your teammates had the highest difference, and blank cells had the lowest difference in ranks."

# Method: Creativity Task



You will have up to 5 minutes to brainstorm as many possible uses as you can for this common household item (see below).

#### **PAPERCLIP**

Idea 1	
Idea 2	
Idea 3	
Idea 4	
Idea 5	
Idea 6	
Idea 7	
Idea 8	
Idea 9	
Idea 10	

## Method: Creativity Task

	Teammate 1 (You)	Teammate 2	Teammate 3	Teammate 4
Idea 1	wire			
Idea 2	hook			
Idea 3	hanger			
Idea 4	bracelet			
Idea 5	necklace			
Idea 6	twist tie			
Idea 7				
Idea 8				
Idea 9		barter good		
Idea 10			Clothes hook	
Idea 11				
Idea 12				
Idea 13				shovel

"The table below highlights the most original ideas from your team. You will have up to 5 minutes to review these ideas and THEN come up with even more ideas."

#### Measures: Contributions to Team Performance

#### **Problem Solving**

- Difference from expert score (T1 and T2)
- Change score (T2-T1)

#### Creativity

- Fluency (number of ideas)
- Flexibility (number of categories)
- Novelty

### Measures: Social Influence

Social Influence  $\phi = .83, .80$ 

- My teammates valued my [expertise/creativity].
- My teammates [had valuable expertise/offered creative ideas].
- I influenced my teammates.
- I was influenced by my teammates.

# Method: Social Loafing

#### Social Loafing, Others ( = .88, .73)

- My teammates contributed less than they should have.
- My teammates tried their best. (R)
- Given their abilities, my teammates did their best. (R)

#### Social Loafing, Self ( $\alpha = .85, .85$ )

- I contributed less than I should have.
- I tried my best. (R)
- Given my abilities, I did my best. (R)
- I didn't want to let my teammates down.(R)

# Measure: Team Viability

#### Team Viability $\phi = .91$

- I really enjoyed being part of this team.
- I feel like I got a lot out of being a member of this team.
- I wouldn't hesitate to participate on another task with the same team.
- If I could leave this team and work with another team, I would. R
- This team has the capacity for long term success.
- This team should not continue to function as a unit. R
- This team has positioned itself well for continued success.

#### **HLM**

(*N*= 145 observations, 47 individuals, 5 repeated measurements)

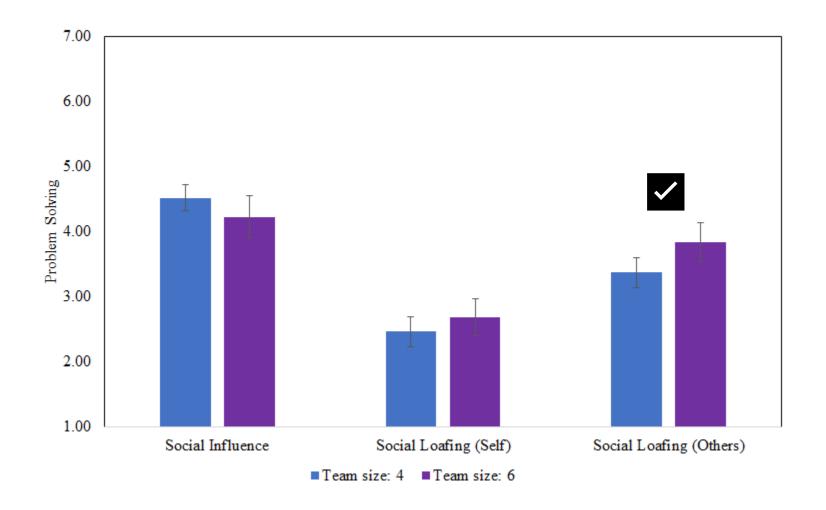
Days in isolation increased social influence, social loafing, and decreased performance contributions

Team size had weaker effects, more of an effect on creative tasks; team size 4 associated with more social influence, less social loafing, more novel ideas contributed to the team

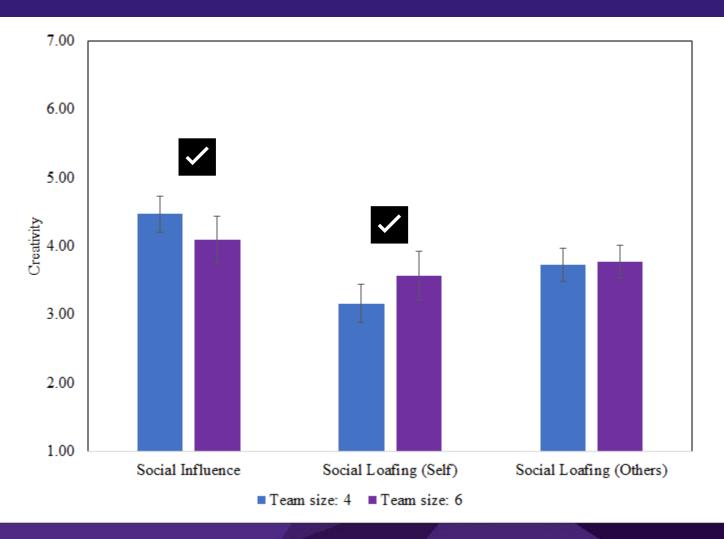
Dependent Variable	Fixed Effect: Team Size	Fixed Effect: Days in Isolation			
Problem Solving Task					
Social Influence	ns	4.91**			
Social Loafing - self	ns	3.99**			
Social Loafing - other	2.3†	2.87**			
Performance improvement	ns	3.63**			
Creative Task					
Social Influence	2.09†	6.58**			
Social Loafing - self	2.41†	5.34**			
Social Loafing - other	ns	2.61†			
Novelty	2.26†	2.58†			
Note. F-values reported; team size tests are one-tailed; † p<.10, *p<.05, **p<.01					

# How does team size affect social influence and social loafing?

# When problem solving - Individuals perceived less social loafing by others on the team of size 4 than size 6

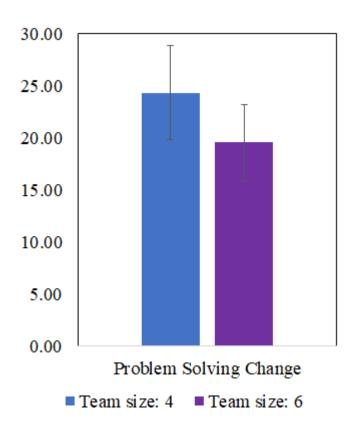


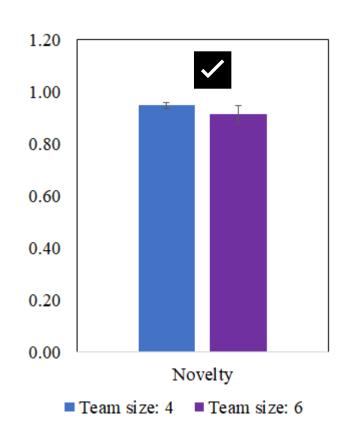
# When ideating on creative tasks - Individuals were more influenced, and reported less social loafing by themselves on the team of size 4 than size 6

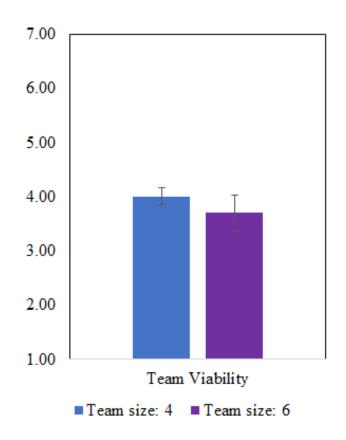


# How does team size affect contributions to effectiveness?

#### Individuals contributed more novel ideas on the team of size 4

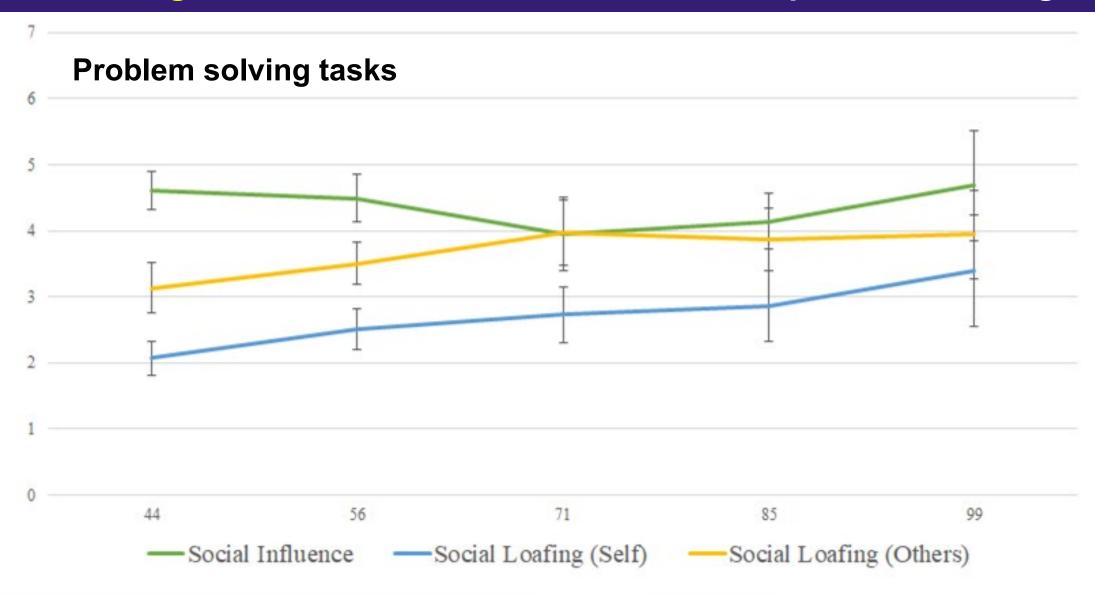




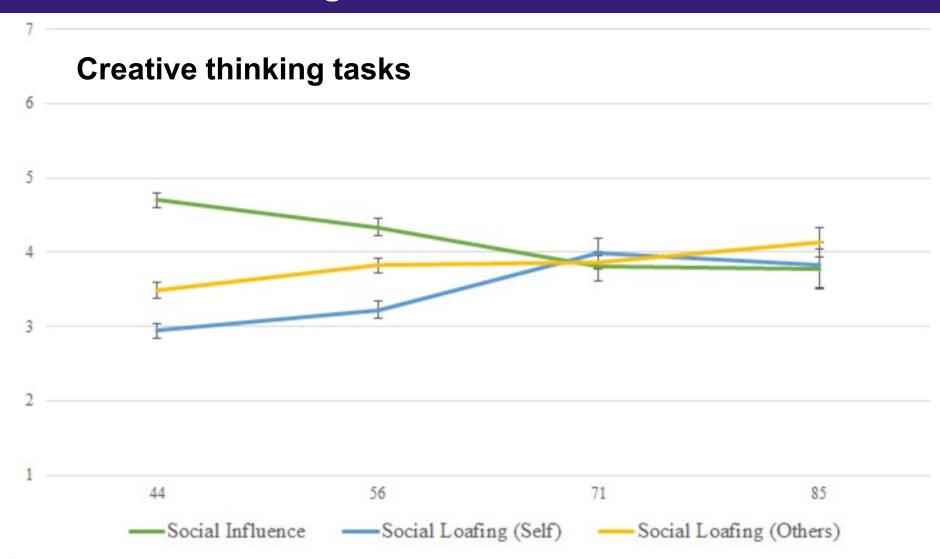


# How does isolation affect social influence and social loafing?

#### Social loafing increased over time in isolation, on problem solving tasks

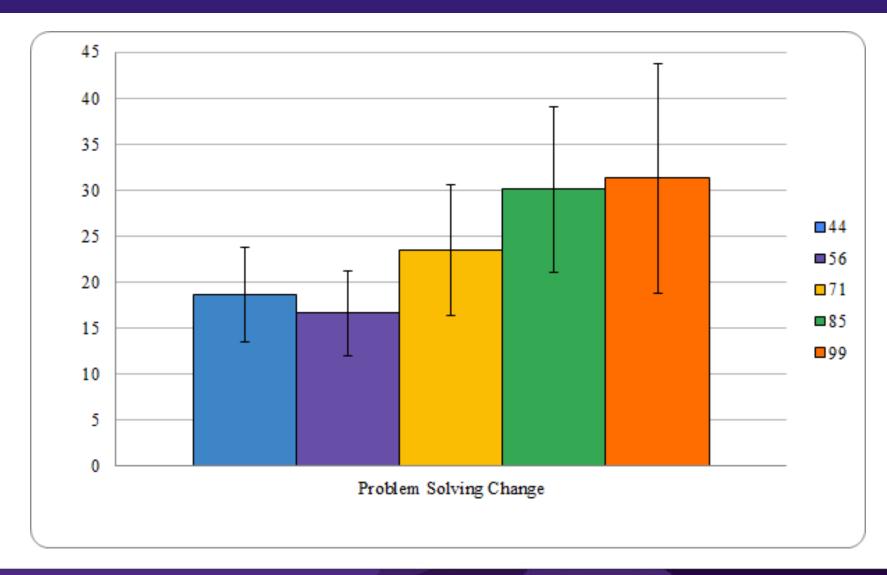


# Social loafing increased, and social influence decreased, over time in isolation on creative thinking tasks

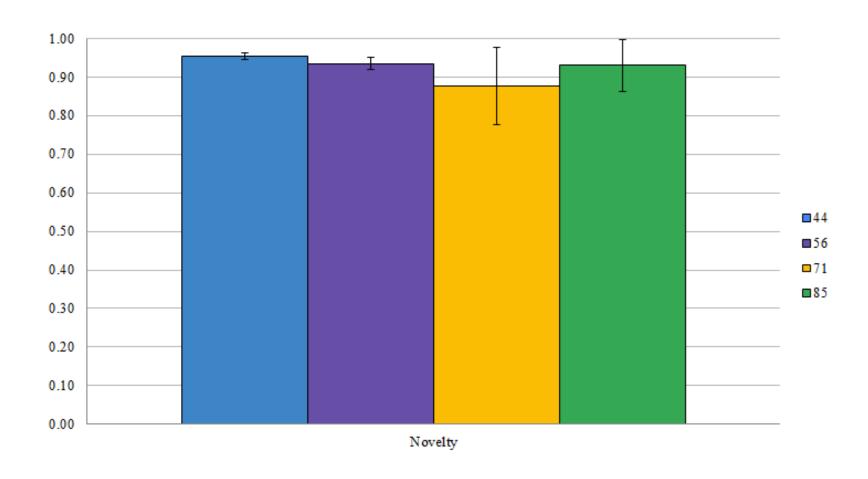


# How does time in isolation affect contributions to team effectiveness?

# Individuals were more influenced by their teammates ideas with more days in isolation



# Individuals contributed fewer novel ideas over time, the fewest was just over 2 months (U shape)



# Findings and Implications

There are many considerations for crew size, but solely from a team perspective, there may be some advantages to smaller teams

- More influenced by teammates ideas
- Greater contributions to performance
- Less social loafing
- Greater viability

## One more finding...

Days in isolation has an important effect on contributions to team performance, these findings replicate those we have observed in HERA where creative ideation and problem solving decline in the 3rd and/or 4th mission quarter

# Thank you!